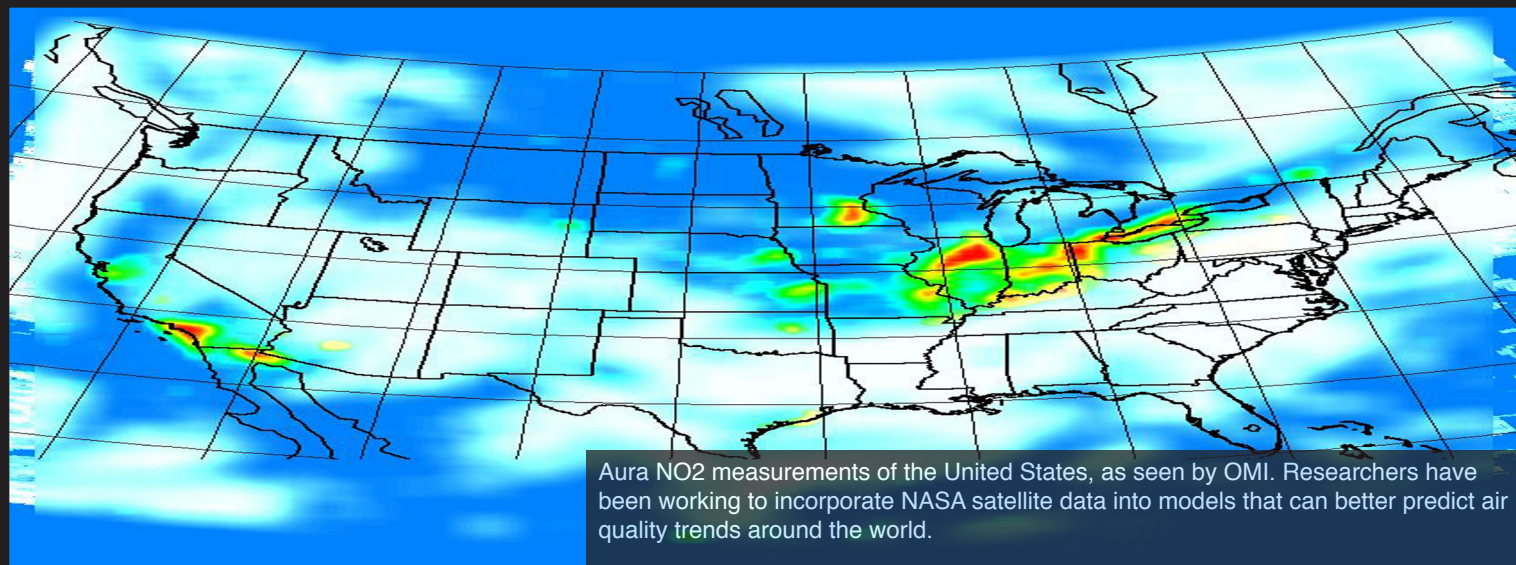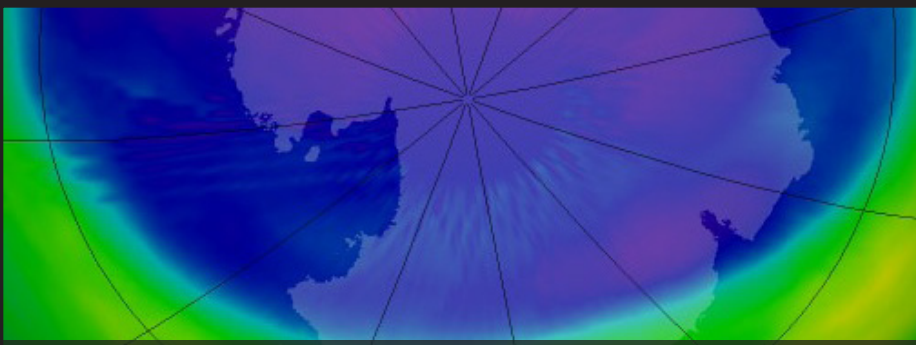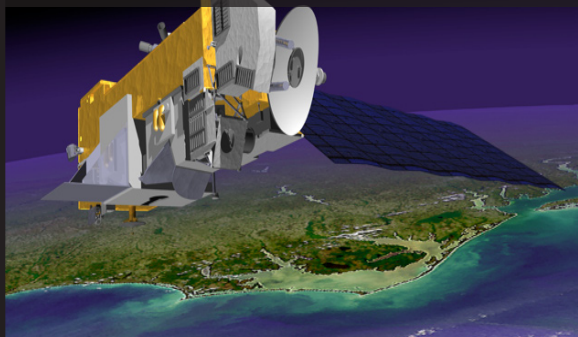# Assimilating NASA Satellite Data into Operational Air Quality Forecast Models

Applying NASA Satellites and Models to Improve Air Quality & Public Health

Aura NO2 measurements of the United States, as seen by OMI. Researchers have been working to incorporate NASA satellite data into models that can better predict air quality trends around the world.

NASA's Aura satellite flying the OMI instrument.

A view of Earth's ozone hole taken by NASA's Aura satellite.

Project Goals

Use NASA in routine numerical air quality prediction models, including EPA's CMAQ

Use NASA Land Information System to improve CMAQ surface data and emissions used in real-time

Benefit state/local air quality forecasters, regional planning organizations and broadcasters through routine improvements in real-time, operational, air quality forecast guidance

Project Outcomes

Increased accuracy in air quality forecasts to reduce health impacts from poor air quality and aid in local mitigation efforts

Improved ability to model/forecast air quality over geographically difficult areas

Ability to extend internationally using GEOSS standards to enable benefits outside the U.S.

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Summary

U.S municipalities and states are required to issue air quality forecasts in real-time in order to protect public health and to implement actions plans. When forecast levels of ozone and particulate matter(PM) 2.5 are at or above unhealthy levels, alerts are issued advising sensitive groups to avoid exposure and requesting the public and cooperating businesses to voluntarily reduce emissions.

This project incorporates NASA Moderate Resolution Imaging Spectroradiometer (MODIS) data into Baron Advanced Meteorological Systems (BAMS) in order to utilize, develop, and run complex numerical air quality forecast modeling systems. These forecast modeling systems provide state and local agencies, as well as broadcast meteorologists, with the information they need to make accurate forecasts. The MODIS data are incorporated into BAMS using an improved remote-sensing algorithm that estimates aerosol optical depth, allowing much more accurate placement of smoke and dust features that contribute to poor air quality. BAMS also utilizes fire pixel data retrieved from MODIS to accurately place the fire sources in the correct forecast model locations. By combining models that simulate weather, emissions and atmospheric chemistry, the BAMS air quality decision support system (DSS) allows forecasters to have increased confidence in the accuracy and timeliness of the official forecasts they are required to issue.

While U.S. air quality has steadily improved over the last decades, recent research has shown that levels of harmful air quality still contribute to more than 60,000 deaths annually in the U.S.. Accurate air quality forecasts are crucial in helping people avoid breathing air containing harmful contaminants.

Project Details

This project applies NASA aerosol optical depth products and imagery from the Terra/Aqua (MODIS) satellites, surface observations of PM2.5, surface visibility observations, the NASA Land Information System, and a data-assimilating version of the Environemental Protection Agency (EPA) Community Multiscale Air Quality (CMAQ) model to provide more accurate real-time, operational air quality forecast guidance over the U.S.

The ability to apply satellite observations to air quality issues derives from decades of investments by NASA and the atmospheric research community in retrieval methods, sensor technology, validation efforts and other scientific research. The contribution by project coinvestigator Christina Hsu, described in Hsu et al., 2004: "Aerosol Properties Over Bright-Reflecting Source Regions" specifically laid the foundation for this project by developing and validating "Deep Blue", the specific remote-sensing algorithm used by BAMS. Earlier algorithms had trouble detecting aerosol plumes over bright reflecting surfaces, including much of the western U.S. desert-like environment, and many urban areas.

Further, the NASA Land Information System (LIS) is the award-winning software package that provides a highly sophisticated framework for modeling the land-surface. The team is integrating LIS into the framework to enhance its ability to forecast both biogenic and anthropogenic emissions, including smoke plumes. Finally, new data sets resulting from the improved DSS are being recast into a format consistent with Global Earth Observation System of Systems architectural standards to enable sharing and expansion globally.